

X.—*Eocidaris and some Species referred to it.*

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[Plate I.]

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PREVIOUS HISTORY OF "*Eocidaris*," AND SELECTION OF GENOTYPE.

In my note on "*Echinocrinus* versus *Archæocidaris*"*

* It is surprising that this note should thus far have produced but a single protest. With that protest—made by Professor J. W. Gregory (Feb., 1908)—I am in complete sympathy. Dr. Gregory says that I

(Nov. 1907) allusion was made to *Eocidaris*. This is a generic name that has been variously interpreted, and some decision concerning it and other names involved had to be come to for my memoir on "The Triassic Echinoderms of Bakony" (in the press). After pages 84-88 containing my conclusions had been passed for press, I learned from Professor R. T. Jackson's letters that he had come to a different conclusion concerning *Eocidaris*, and I now find his view supported by Professor H. Lyman Clark in his valuable synopsis of "The Cidaridæ" (Dec. 1907).

Professor Jackson and I agree that "*Eocidaris*" is a nuisance, and we should be only too glad to get it decently out of the way. The process of sepulture adopted by Professors Jackson and Clark is to take *Cidaris keyserlingi* Geinitz as genotype, and in consequence to regard *Eocidaris* as a synonym of *Cidaris*. This seems to me to be rather a mock funeral. Granting for the moment that *C. keyserlingi* might be the true *Eocidaris*, then, in the first place, one would want to be quite certain as to the meaning of "*Cidaris*," a question to which every recent authority gives a different answer (Bather, March & July, 1908); secondly, I should deny that *C. keyserlingi* was a *Cidaris*, even as that genus is interpreted by Professor Clark, and I should feel obliged to retain the name *Eocidaris* for a genus better known by at least one other name, namely *Miocidaris*.

But I did not feel bound to take *Cidaris keyserlingi* as genotype of *Eocidaris*; on the contrary, simple adherence to

advocate the use of *Echinocrinus*. Not so: I have merely pointed out that all accepted rules compel such use. Were there any tribunal before which this question might be laid as an open one, I should plead for the absolute rejection of *Echinocrinus*. If the Committee on Nomenclature appointed by the International Congress of Zoologists is to be constituted such a tribunal, I hope that Dr. Gregory, Dr. Jackson, and others will join me in submitting this case for its decision. I am ready to accept its decision. Is Dr. Gregory likewise ready?

Unless zoologists wish to go on wasting their time in futile squabbling over these dreary questions of nomenclature, they must adhere rigidly to the rules drawn up by the only existing body that can be considered at all representative; or, in cases of doubt and obvious grave inconvenience, they must accept as final the ruling of that same body. In these debatable matters there is no other method of applying "common sense"; the alternative is independent judgment, and from that we have suffered too long already.

P.S.—This footnote was written some months before several British zoologists raised the general question in 'Nature' (p. 394; 27 Aug., 1908) and at the Dublin Meeting of the British Association (see 'Nature,' p. 647; 22 Oct., 1908). With their protest I agree, so far as I understand it; but I do not understand what practical results are expected from the resolution that was passed.

the rules of nomenclature, without regard to ulterior consequences, seemed to have reduced *Eocidaris* to two species so obscure that no one was likely ever to learn more about them. Thus *Eocidaris* was, one hoped, quietly laid on the shelf.

It now seems advisable to defend in greater detail the conclusions set forth in my memoir with a brevity that might have been praiseworthy had everyone been prepared to accept them.

Desor (1856, 'Synopsis,' p. 155) based the genus *Eocidaris* on interambulacral plates and radioles. "Ces plaques étant hexagonales, elles doivent par conséquent rentrer dans la tribu des Tessellés. Un gros tubercule par plaque. Ce tubercule est à base lisse et perforé au sommet, mais il diffère de ceux du genre *Archæocidaris* par l'absence d'un second anneau. Ambulacres inconnus. Radioles grêles, garnis de petites épines sporadiques." It is clear from this that, not only was *Eocidaris* defined as one of the Tessellati, but that it belonged to the Family now called Archæocidaridæ or Lepidocidaridæ. In short, the generic concept was precisely that which has subsequently given rise to *Cidarotropus* (see Bather, Nov. 1907).

To *Eocidaris* Desor referred six species, in an order governed by their stratigraphical position, the newest coming first:—

[<i>Cidaris</i>] <i>kaiserlingii</i> [sic] Geinitz.	Lower Zechstein.
<i>Palæchinus verneuillanus</i> King.	Permian.
<i>Cidaris rossica</i> Buch.	Carboniferous.
<i>Echinocrinus munsterianus</i> Koninck, M'Coy.	Carboniferous.
<i>Cidaris larispina</i> Sandberger.	Devonian.
<i>Cidaris scrobiculata</i> Sandberger.	Devonian.

Of these species *C. rossica* was included with doubt, since Desor was not certain that the plate was hexagonal. *E. munsterianus* was placed here only on the doubtful evidence of a radiole. It therefore follows that the genotype, when ever selected, must be one of the other four species.

We have now to see what action has been taken by subsequent authors.

H. B. Geinitz (1861, p. 108) accepted Desor's reference of *Cidaris keyserlingi* to *Eocidaris*, and said that the interambulacrals were "sehr deutlich sechsseitig," but his figures (Taf. xx. figs. 7, 8, 9) show plates that are obviously five-sided. The same author (1866, p. 61), describing a new species, *Eocidaris hallianus*, did not discuss the genus in any way.

J. Hall (1867-70, p. 341) referred *Echinus drydenensis*

Vanuxem to *Eocidaris*, and based on that species a more detailed diagnosis of the genus. He did not discuss the European species of *Eocidaris*.

Quenstedt (1872-5, p. 162) compared *Palæchinus verneu-
iliana* [sic] King with his own *Cidaris coævus* [sic], but did not regard them as *Eocidaris*. He mentioned Desor's reference of *Cidaris keyserlingi* Geinitz to *Eocidaris*, but pointed out that the later figures showed the species to have interambulacra of true Cidarid type. On p. 374 he alluded to Desor's reference of *Cidaris rossica* to *Eocidaris* because of its lack of a basal terrace, but preferred with Trautschold to leave it in *Archæocidaris* (= *Echinocrinus*). "According to this criterion," he said, apparently with a touch of sarcasm, "the little remains of *Cidaris levispina* and *C. scrobiculata* . . . should belong to *Eocidaris*." These at any rate are the only species that Quenstedt left in *Eocidaris* in so far as he accepted the genus at all.

S. Lovén (1875, p. 42) gave a diagnosis based on Desor, and included the following species in order: *E. keyserlingi*, *E. verneu-
iliana*, *E. scrobiculata*, *E. levispina*, *E. drydenensis*. He placed the doubtful *C. rossica* and *C. munsteriana* in *Archæocidaris*. Otherwise his remarks are not so helpful as those of Quenstedt.

A. Pomel (1883, p. 113) says that *Eocidaris* "Ne paraît différer d'*Archæocidaris* que par ses tubercules, dont la base manque de la crête concentrique au cercle scrobiculaire." He thinks it may include the radioles known as *Xenocidaris*, and mentions the following species in order: *E. keyserlingi*, *E. verneu-
iliana*, *E. scrobiculata*, *E. drydenensis*. It is clear that Pomel was acquainted neither with the fossils themselves nor with the remarks of Quenstedt.

The latter, at any rate, were known to W. Waagen (1885, p. 818), who, however, erroneously says "Quenstedt admits only the carboniferous species in the genus *Eocidaris*." Waagen probably meant that Quenstedt removed from *Eocidaris* the Permian and possible Triassic species. Waagen himself makes the curious and untenable suggestion that *C. grandæva* Goldf. has hexagonal interambulacral plates figured by Quenstedt, and had better be transferred to *Eocidaris*. In *Cidaris forbesiana* Kon., which he here refers to *Eocidaris*, Waagen describes "a deeply crenulated collar" round the mamelon, and in comparing this species with *Eocidaris rossica* he twice insists that the absence of crenelation in that species is only apparent, and due to weathering. Why Waagen, in opposition to Desor's clear statement, should have thought crenelation a character of *Eocidaris* is nowhere explained.

Down to this point it is perfectly plain that *Eocidaris* was universally regarded as a Palechinoid or Tessellate, with hexagonal interambulacrals of Lepidocidaroid type, differing from those of *Echinocrinus* (or *Archæocidaris*) in the absence of a basal terrace. It had further been pointed out by Quenstedt that *Cidaris keyserlingi* and *C. verneuiliana*, not to mention *C. coæva*, could not be placed in *Eocidaris* because they were Cidaridæ and not Palechinoids. The two species *C. rossica* and *C. munsteriana*, in addition to having been doubtful from the beginning, were now generally referred to *Echinocrinus*. There remained then available for the type of *Eocidaris* only the two Devonian species *C. levispina* and *C. scrobiculata*. The various American species, notably *E. drydenensis*, though often utilised for the interpretation of the genus, never had any claim to be regarded as genosyntypes.

This clear and, from the nomenclatorial standpoint, satisfactory state of affairs was all of a sudden complicated by the irruption of an enthusiastic student of recent scaphrinids. In giving a summary of various Cidaridæ with flexible test, L. Doederlein (1887, p. 39) correctly turned his attention to *Cidaris keyserlingi* Geinitz, and, being desirous of keeping this in a genus distinct from the recent *Cidaris*, he retained for it the name *Eocidaris* given to it by Desor and accepted by Geinitz at a time when its true structure was not realised. Dr. Doederlein himself gave a more detailed and more correct description of an interambulacrum of the species from the Zechstein of Pössneck, and, in consequence of the facts thus elicited by him, he drew up the following diagnosis of *Eocidaris*:—"Palæozoische Cidariden von geringer Grösse, mit schneidendem ambulacraren Rand des I[nter]A[mbulacral] F[eld]. Coronalplatten in geringer Anzahl; Hauptwarzen klein, gekerbt; Warzenhöfe elliptisch, etwas vertieft, zusammenfliessend; Scrobicularring nicht auffallend. Arten: *Keyserlingi* aus dem Zechstein u. a." Note the plural, "und andere."

Into the details of Doederlein's account, more than confirmed in the contemporary description by Kolesch (June 1887), we need not enter for the present. Sufficient to note that both these accurate observers followed Quenstedt in maintaining the truly Cidarid nature of the species before them. The questions that now concern us are: first, did Doederlein intend to fix on *C. keyserlingi* as the genotype? Secondly, had he the right so to do? Both these questions I answer in the negative. As for the first, there is no reason to suppose any such thing, since Doederlein fixed on

no genotype for any of the other genera, whether new or old, discussed by him. He mentioned *E. keyserlingi* by name because it was the form next to his hand, and it was not his purpose to investigate all the other species of the genus; or, to look at the matter from the other side, he used the name *Eocidaris* for his new generic concept merely because he found the name already in use*. But, even assuming that he did mean to fix on *C. keyserlingi* as the genotype of *Eocidaris* Desor, I maintain that he was prevented by the prior action of Quenstedt, who had seized on the essential point and removed *C. keyserlingi* from *Eocidaris*.

In coming to this conclusion, I am glad to find myself essentially in accord with Dr. A. Tornquist, who, since he too hailed from Strassburg University, was doubtless familiar with the views of his colleague. In 1896 (p. 38) he discussed the validity of *Eocidaris*, and once again pointed out that *C. keyserlingi* was a true Cidarid. But to interpret *Eocidaris* by *C. keyserlingi*, and to place it in the Cidaridæ, as Zittel had done (1895, p. 186), was, he maintained, far from Desor's intention. *Eocidaris* must remain in the Archæocidaridæ; that there really did exist forms corresponding to the diagnosis of Desor, had been proved by the American *Eocidaris drydenensis* and *Lepidocidaris squamosa*, while European representatives were *Eocidaris scrobiculata* and *E. verneuilliana*. As for *Cidaris rossica*, though some of its interambulacra, notably in the adambulacral columns, were devoid of a basal terrace, and therefore of *Eocidaris* type as Desor supposed, others had that structure and therefore justified the reference of the species to *Archæocidaris* (= *Echinocrinus*). Both here and in a later paper (1897, p. 48=770), Dr. Tornquist showed a strong inclination to interpret *Eocidaris* in the light of *E. drydenensis*. But this species, being unknown to Desor, could not be taken as genotype. Essentially, then, Tornquist confirmed Quenstedt, by transferring *C. rossica* and by eliminating *C. keyserlingi*: "für diese ist allenfalls eine neue Gattung aufzustellen, wenn man sie nicht mit *Cidaris* vereinigen will."

So far as *Eocidaris* was concerned, the same position was taken up by that very learned writer on fossil Echinoids, Mr. J. Lambert (1900, p. 38). Having pointed out that *E. keyserlingi*, *E. verneuilliana*, and *E. rossica* did not agree in essential points with Desor's diagnosis, he referred them

* The International Code of Zoological Nomenclature (1907) says under Article 30, rule *g*: "The meaning of the expression 'select a type' is to be rigidly construed. Mention of a species as an illustration or example of a genus does not constitute a selection of a type."

respectively to *Eotiaris* n. g., *Permocidaris* n. g., and *Archaeocidaris* sens. restr. The last of these was discussed in my previous paper (Nov. 1907); to the other two we shall recur. Here it need only be noted that the result of Lambert's action, as of Quenstedt's, was to leave in *Eocidaris* only two of the original species—*E. levispina* and *E. scrobiculata*.

I conclude, then, in opposition to Professors Jackson and Clark, that we are bound by the actions of Quenstedt, Tornquist, and Lambert to regard *Eocidaris* as restricted, partly by elimination, partly by definite statement, to the two Devonian species of Sandberger*. To prevent further confusion it is necessary to fix on one of these as genotype, and, in making a choice, regard should be had to the fact that in *E. levispina* the radiole has been described as well as the interambulacra. Therefore I decide on that species, and to avoid all other sources of confusion I indicate as its type (lecto-holotype) the original of Sandberger's pl. xxxv. fig. 2 a, which figure corresponds most closely with Sandberger's own description (1855, p. 382).

Whether this conclusion is fortunate or unfortunate we need not stop to decide, since that can have no bearing on its correctness. At any rate, as will appear in the sequel, it disposes of the name *Eocidaris* more effectually than the action of Professors Clark and Jackson; therefore they, at least, should be satisfied.

EOCIDARIS LEVISPINA AND *E. SCROBICULATA*.

It would be of more interest to discuss the validity and systematic position of *Eocidaris* as thus interpreted, and here it is indeed unfortunate that the materials for a decision are so scanty. A few remarks may, however, be ventured on Sandberger's specimens, which were very kindly lent to me in January, 1908, by the Natural History Museum of the town of Wiesbaden. My thanks are due to Geheimer-Sanitätsrath Dr. Arnold Pagenstecher and to Dr. E. Lampe for leaving the specimens in my hands so long.

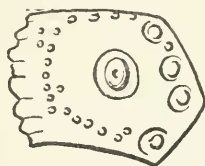
The specimens, which come from the Middle Devonian Stringocephalus Limestone of Villmar, are all much broken, with surfaces weathered and decorticated, and with the natural margins of the plates destroyed.

Taking the first genotype, *Eocidaris levispina*, we turn to the lecto-holotype, the original of Sandberger's fig. 2 a

* G. & F. Sandberger, 1855. The expression "Sandberger" is used throughout, to avoid cumbrous repetition.

(our Pl. I. fig. 1). This is an interambulacral plate, with mamelon elongate, probably in a meridian direction, perforate, the perforation similarly elongate, rising from a slight platform, now almost entirely broken away and retaining no trace of a parapet if ever there was one. The boss passes with a gentle convexo-concave slope, and no trace of a basal terrace, into the slightly depressed area, which is bounded by no distinct rim. There appears to have been a complete circle, perhaps a trifle flattened above and below, of scrobicular tubercles. Those on one side, to the number of four, were larger than the others, were doubtless mamelonate, and though much worn still show faint traces of scrobiculation; they may be called secondary tubercles. Those on the other side were much smaller, more numerous, numbering 8 or 9, and rather irregular in position; they may be called tertiary tubercles. Their mamelons, still clearly preserved in some cases, were almost certainly imperforate, as stated by Sandberger, and in no way justify Desor's suggestion of perforation, which was doubtless based on some obscure marking in Sandberger's figure. The tertiary tubercles can be traced across one end of the scrobicule (the left in our figure), and

Fig. 1.



Restored diagram of holotype of *Eocidaris levispina*,
enlarged $2\frac{1}{4}$ diameters.

there is some indication that they formed a similar line at the other end, but that margin is more broken away. The extra-scrobicular tract adjoining the lateral tertiary tubercles slopes sharply downwards, and bears three elevations (there may have been a fourth, to the right in our figure). These elevations do not appear to be the remains of tubercles, but seem rather to represent a folding or denticulation of that margin of the plate. This suggests that the margin in question is adambulacral, a view consonant with the position of the larger (secondary) tubercles on the opposite side of the scrobicule. On this evidence we may, perhaps, venture to reconstruct the plate as shown in the annexed diagram (text-fig. 1).

The original of Sandberger's fig. 2b (our Pl. I. fig. 2) is
4*

a fragment, preserving only the mamelon, part of the boss, and faint traces of about half the serobicular ring of tubercles, all apparently tertiary; there is no trace of any secondary tubercle. Since this agrees with the lecto-holotype in all those characters that are preserved, it may well belong to the same species; and, if so, it indicates that the platform round the mamelon was slightly hollowed, or, in other words, had a slight parapet; the mamelon itself is much depressed, and has a very short neck, which is not undercut.

The original of Sandberger's fig. 2 (our Pl. I. fig. 3) is too much broken and worn to afford any safe evidence. It may belong to the same species, and at any rate presents no features inconsistent with the preceding account. There is another imperfect plate, unfigured, of much the same character.

The original of Sandberger's fig. 2 *d* is the proximal end of a primary radiole (our Pl. I. fig. 4). The evidence on which this is referred to the same species as the three interambulacral plates is merely the occurrence of this and similar fragments in the same stratum as those plates, and the general correspondence in size between its acetabulum and the primary tubercles of the plates. The shaft is subcylindrical and smooth, but the radiate septa of its microstructure are just visible on the surface as fine longitudinal striæ. Its diameters are 3.9 mm. and 3.3 mm. There is no trace of an axial lumen. No collerette can be detected. The annulus swells out gently to diameters of 4.8 and 3.7 mm., and passes with a slight concave curve into the gently rounded base. The acetabular margin is a smooth raised rim, much worn in the specimen, with outside diameters of 2.9 mm. and 2.1 mm. Since the base has been cracked and is traversed by a vein of calcite, the longer diameters of annulus and acetabulum should be taken as about .5 mm. shorter than the measurements given.

The original of Sandberger's fig. 2 *c* is the proximal portion of a radiole, 14.6 mm. long. It is attached to a fragment of crystalline limestone, and its outer layers are stained, like most of the limestone, a light pinkish red. All the other specimens are of a dull grey colour. In this radiole the shaft appears to have been relatively thinner than in the original of fig. 2 *d*, being 2.7 mm. in both directions at the distal end, and to have tapered more towards the proximal end, where it has a diameter of 2.3 mm., and then expands again towards the annulus. The base is of the same general character as in fig. 2 *d*. The chief difference lies in traces of a longitudinal ridging, exceedingly obscure, but apparently

quite different from the smooth surface of fig. 2 *d*. The longitudinal striation due to the microstructure is seen on the ridges and in the spaces between them. The number of ridges to be detected on one side of the shaft is 13 or 14; but I am unable to see that they occur on the other side of the shaft. The difference in form of the shaft, the different matrix, and the suggestion, obscure though it be, of a different ornament, render it probable that this radiole does not belong to the same species as the other radiole; and, if either be conspecific with the lecto-holotype of *Cidaris laevispina*, it is more likely to be the original of Sandberger's fig. 2 *d*. Two other fragments, unfigured, are of the same nature as the latter specimen, and show that the radiole was slightly fusiform, smooth, and finely striate throughout.

Miss Mary Klem (1904, p. 69) gives as the sole description of this species: "Primary spines cylindrical and ornamented with about twenty-three longitudinal ribs. These ribs are muricated oppositely." This information is not given by any of the authors quoted by Miss Klem, and she does not say that she has herself examined any specimens. Of the two radioles figured by Sandberger, that which probably belongs to the species is neither cylindrical nor ribbed; the other one may possibly have been ribbed, but there is no evidence that its ribs were muricate.

The holotype of *Cidaris scrobiculata* Sandberger (their fig. 3, our Pl. I. fig. 5) is an interambulacral plate of about the same area as the lectotype of *C. laevispina*, but apparently less thick and with a less prominent boss. The mamelon, platform, boss, and scrobicule are of the same general character as in *C. laevispina*; but the mamelon is not so much extended, the scrobicular ring is circular, its tubercles, which show faint traces of scrobiculation, are intermediate in size between the secondaries and tertiaries of *C. laevispina*, and appear to have been more regular and more equally spaced. The extra-scrobicular surface was probably smooth.

The Sandbergers may have been right in regarding this specimen as of a different species; but if one were to maintain that it came merely from a different part of the test of *C. laevispina*, I do not see how that could be disproved. There certainly seems no reason for Desor's suggestion that it may belong to a different genus.

The systematic position of these two species is doubtful. Since the outlines are not preserved in any of the plates, the only evidence that they belong to a genus with more than two columns of interambulacrals to an area is the *à priori* evidence afforded by their antiquity. This, however, must be accepted in the absence of proof to the contrary.

The feature seized on by Desor, the absence of a basal terrace, is not enough to distinguish these species from *Echinocrinus* (= *Archæocidaris*), especially when so few plates are known. Still the general nature of the ornament, at least in *C. levispina*, and more particularly the character of the radioles, are enough to warrant the separation. The radiole of *C. levispina* rather resembles those of *Lepidocidaris squamosa*, as I judge from excellent photographs kindly lent me by Professor Jackson, but that species has slight extra-scribicular ornament. Without knowledge of larger portions of the test, it would be quite unsafe to refer *Cidaris levispina* to either *Echinocrinus* or *Lepidocidaris*; but there seems no reason why it should not remain in the *Lepidocidaridæ*, as genotype of a distinct genus, *Eocidaris* Desor.

CARBONIFEROUS SPECIES REFERRED TO *EOCIDARIS*.

The discussion of the American species at one time or another referred to *Eocidaris* may safely be left to Professor Jackson, who will, one hopes, at last provide a figure of the much-discussed *E. drydenensis*. The others are *E. blairi* Miller (1891, p. 73, pl. xii. ff. 1, 2) and *E. hallianus* Geinitz (1866).

Neither does it seem necessary to say more about *Eocidaris rossica* and *E. munsteriana*, which have been dealt with by Tornquist, Hesse, and others, and will receive further attention from Jackson. Both doubtless belong to *Echinocrinus*.

PERMIAN SPECIES REFERRED TO *EOCIDARIS*.

For detailed information regarding *C. keyserlingi* we are indebted mainly to K. Kolesch (1887), but also to Doederlein (1887), E. Spandel (1898, pp. 33-37, pl. xiii. ff. 1-6), and E. K. Hesse (1900, pp. 213, 214). Good specimens from Pössneck in the British Museum (E 1119, E 1121) have enabled me to check several of the statements made by these authors.

In supposing the shape to be that of an ordinary *Cidaris* or *Hemicidaris*, Spandel seems to be more correct than Kolesch, who perhaps forgot to leave enough room for the apical system.

In assigning to a single interambulacral column six full plates, Spandel is probably nearer the truth than Kolesch with his seven plates, and certainly nearer than Doederlein with his four or five.

Spandel, however, seems to think that there was at the

adoral end of each interambulacrum "ein Halbtäfelchen, wodurch die paarigen Interambulacralreihen, in welchen die Asseln alternieren, gegen das Peristom beglichen werden." It must not be inferred from this that there was any relic of the primitive median single interambulacral; the plate in question is merely the adoral plate of either the *a* or *b* column in process of resorption. This, if reckoned in, gives 7 plates to the column in which it lies.

Doederlein, Kolesch, and Spandel agree with Quenstedt in describing the interambulacral plates as five-sided. It is only the extreme adoral or adapical plates that may be four-sided in consequence of resorption or incomplete growth respectively. As regards the normal interambulacrals, Spandel is right in describing the adoral margin as convex, the adapical as concave; but this is not always obvious, nor is the curve very regular.

Doederlein noticed that the adambulacral margin was sharply bevelled underneath, "schneidend"; but it was left for Spandel to observe the denticles on the bevel (see his pl. xiii. f. 4 *b*). This is confirmed by Brit. Mus. E 1121 (Pl. I. fig. 6), which further shows that the regular denticulation seen in Spandel's figure is characteristic of the ambital interambulacrals. Nearer the peristome the bevel forms a less acute angle and the denticulation is less regular. This agrees with what may be observed in allied species; but for a full discussion of these interesting structures I must refer to my memoir on the Bakony fossils. The same specimen shows that there are about four denticles to each ambital interambulacral (as figured by Spandel), whence it may be inferred that there were also about four ambulacrals to the interambulacral. Kolesch, arguing from the external view of the margin, likewise inferred that 3-4 ambulacrals went to a small interambulacral, 5-6 to the largest ones. The denticles are not quite at right angles to the adradial margin, as might be inferred from Spandel's figure, but slope slightly adradially and adorally, and from this it follows that the ambulacrals lay at a corresponding angle.

In the 'Triassic Echinoderms of Bakony' the structure of the sutures between the interambulacral plates in this and allied species is discussed at some length, and my inability to follow Spandel's account is there explained. Here it will be enough to give the conclusions based on an independent examination of the British Museum specimens as interpreted in the light of the *Lepidocidaridæ*.

MARGIN	<i>adradial.</i>	<i>adapical.</i>	<i>adoral.</i>	<i>apicad-interradial.</i>	<i>orad-interradial.</i>
BEVEL FACING	inwards.	inwards.	outwards.	inwards.	outwards.
NATURE OF SUTURE:	transverse denticles.	ridge on inner margin, sometimes.	ridge on outer margin, usually.	smooth.	smooth.

According to Spandel, the ridge serves as a stop ("Widerlager") for the adjoining plate; but his view is inconsistent with the existence of a ridge on both upper and lower margins. There is more probability in the opinion expressed by Tornquist (1896), in reference to a similar structure in *Echinocrinus*, that the ridge merely marks a groove for the attachment of the uniting ligament. On this view, the presence of a ridge would indicate greater rather than less flexibility. The interambulacra of *Cidaris keyserlingi* must, however, have been united somewhat firmly, since large portions of ambulacra are more common than isolated ambulacra, and, except on the adradial margins, they are bounded by fractures rather than by sutural surfaces.

The same fragment (E 1121) that shows the denticulation so plainly also bears witness to considerable thickening of the interambulacrum towards the peristome and to the existence of an internal prominence on each side of the interambulacrum, for the attachment of the jaw-muscles. It is curious that no remains of the jaw-apparatus, which this species certainly possessed, have yet been recorded.

In reference to the structure of the main tubercle, Kolesch criticises Geinitz and is in turn criticised by Spandel. Briefly put, the mamelon is perforate, depressed hemispherical, with slightly undercut neck, supported on a flush platform of nearly twice the diameter of the neck, having well-marked crenellæ, of which the number rises to thirteen in the larger ambital plates; from this the boss slopes with slightly concave curve to the depressed definite scrobicule, and, while generally smooth, is occasionally marked by slight folds apparently continuous with the crenellæ. The scrobicule is not so much a transverse ellipse as a circle, which is truncate above and below where contiguous or, as in younger individuals and plates, confluent with the adjacent scrobicules. There is no definite ring of scrobicular tubercles, but the extra-scrobicular surface is covered with close-set,

imperforate, rounded eminences, varying in size, and the larger of them apparently mamelonate (*i. e.* tubercles). From 5 to 7 of them border one side of a larger scrobicule, and the same number its other side. The larger scrobicules are usually separated by a single line of about 3 to 5 miliaries (or possibly tubercles).

As regards the radioles, I have nothing to add to the accounts of Kolesch, Spandel, and Hesse (Pl. I. fig. 7).

Most of the writers who have dealt with *Cidaris keyserlingi* have discussed its relations to *C. verneuiliana* (King). While King, Geinitz, and Spandel have regarded them as a single species, Desor and Kolesch have separated them, though admitting their close relationship; but it has been reserved for Lambert (1899, 1900) to place them in two distinct genera—*Eotiaris* and *Permocidaris*.

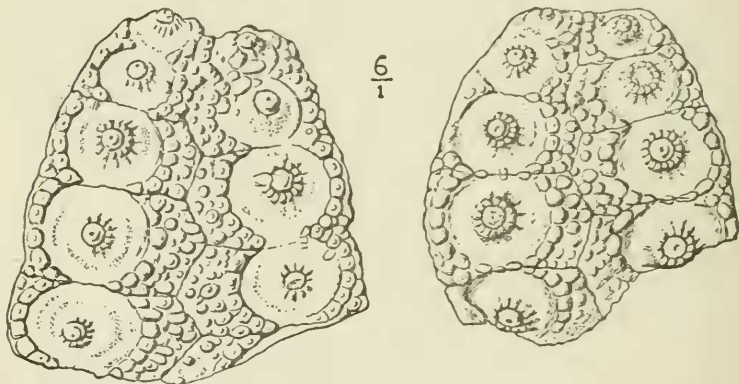
How far any of these writers have based remarks on a study of actual specimens of the two species, they have not told us. The following remarks are based on the specimens of *Cidaris keyserlingi* in the British Museum, which have just been described, and on a large series of specimens of *Cidaris verneuiliana* from Tunstall Hill now preserved in the Hancock Museum, Newcastle-on-Tyne, and kindly lent me by the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne. Unfortunately the originals of King's figures (1850, pl. vi. ff. 22-24) are not among these specimens, and Mr. E. Leonard Gill, the curator of the Hancock Museum, has not been able to find them. There can, however, be no doubt as to the specific identity of the interambulacra with those originally described (1848) and subsequently figured by King.

The differences that Desor thought could be seen in *C. verneuiliana* were the more granular interradianal tract, the more complete scrobicular rings, and the radiating folds around the base of the mamelon. These differences are clearly shown in his figures; but in them certain small details of the original figures have been grossly exaggerated. It should be quite clear from the preceding description that the interradianal tract is quite as closely crowded with miliaries or with small tubercles (the granules of Desor), and the scrobicular ring is often quite as complete, in *Cidaris keyserlingi* as in any specimen of *C. verneuiliana*. This was admitted by Kolesch, who, however, still maintained that, "die radiären Vertiefungen, welche sich an der Warzenbasis von *Eocidaris verneuiliana* befinden, charakterisieren den letzteren als besondere Spezies" (p. 661). Now it is a little difficult to understand what Desor and Kolesch meant by these "plis

rayonnants" or "radiären Vertiefungen." King merely said "*Glencoid circles* radiately crenulated," words that refer solely to what is here called the crenulate platform of the boss, and in this respect there is no difference between the German and the British specimens. If the words of Kolesch are due to an independent study of interambulacra from the Magnesian Limestone, he may be referring to the fact that the depressions between the crenellæ are occasionally prolonged faintly down the slope of the boss. Such an occurrence, however, is not uncommon in other allied species, and has been observed by both Spandel and myself in *C. keyserlingi*. What differences Lambert thought he could see between these two species, does not appear in his writings: we shall return to *Permocidarid*, which he defines as an *Archæocidarid*, and it will then be clear that *C. verneuiliana* can have nothing to do with such a genus.

Fig. 2.

Fig. 3.



Miocidarid keyserlingi. Two of the most perfectly preserved fragments of interambulacra from the Magnesian Limestone of Tunstall Hill, co. Durham, showing the association and general shape of the plates. In fig. 2 the scrobicules are confluent; in fig. 3 they are confluent above, but merely contiguous in the ambital region.

The species described by King, though referred by him to *Archæocidarid* in his text (1850, p. 53) and to *Palæchinus* in the legend to his plate, is in fact a *Cidarid*. "The sub-hexagonal form of the plates which . . . principally led" him "to regard it as an *Archæocidarid*" must be assigned to the imperfection of his specimens. There are before me 11 fairly large fragments of interambulacra, each with two columns, but none with more. The outer lateral margins of

the individual plates may occasionally be convexly curved, and a slight accentuation of this appearance might give rise to the idea that the plates were subhexagonal or heptagonal. But that these are the adambulacral margins, and that the interambulacra therefore are pentagonal, is conclusively proved by one portion of an interambulacrum. This consists of two columns, with apparently six plates to each column, and its inner surface is fully exposed (Pl. I. fig. 9). This in all essential details resembles the similar inner view of an interambulacrum of *C. keyserlingi* from Pörsneck; it has the same denticulate margins and the same thickenings at the peristomial end for the jaw-muscles. It confirms not only the view that the two specimens belong to the same species, but also the reference of that species to *Miocidaris*.

The secondary tuberculation of the interambulacra from Tunstall Hill displays slight variation. In some the whole extra-scribicular surface is filled with closely set secondaries of equal size (Pl. I. fig. 12); in others the tubercles of the scribicular ring are slightly, but distinctly, larger than those in the interradiar space (Pl. I. fig. 11); in others again the tubercles are less closely set, and bare tracts are seen between them (Pl. I. figs. 10, 13). The development of the secondary tubercles is of course greatest in the ambital region and in individuals of largest size; but apart from this there are individual differences. The relative width of the interradiar tract also varies, and the wider tracts naturally have more tubercles; thus in an interambulacrum 8 mm. wide at the ambitus, the width of the interradiar tract, including the scribicular rings, is 2.1 mm., and there are 5 or 6 tubercles in that width (Pl. I. fig. 13); in another specimen the corresponding measurements are 9.4 mm. and 3.5 mm., and the number of tubercles is 7 or 8 (Pl. I. fig. 12).

The secondary tubercles, when well preserved, are seen to have small, apparently imperforate mamelons.

The material from Tunstall Hill includes 7 radioles; the one figured by King came from Humbleton Hill and was the property of Mr. Geo. Tate. Of these 7, the longest complete (or almost complete) one is just 8 mm. long, and the greatest diameter of its shaft is 1.1 mm., this being at about one-third from the distal end. The greatest thickness exhibited by any of these radioles is 1.6 mm., but this is largely due to the prominence of the thorns. The annulus is prominent, with a diameter nearly equal to that of the shaft—1 mm. in the first-mentioned example; from it a straight slope leads to the crenelate acetabular rim. No definite collerette can be distinguished, but the proximal

region (about one-third) of the shaft is smooth, with a fine longitudinal striation. The distal region is beset with small thorns having a distal rake; in some of the specimens these are not clearly seen, in one they are in distinct longitudinal rows (Pl. I. fig. 15), and in another, where they are particularly prominent, they form curved transverse rows (Pl. I. fig. 16). King thought that there were two sorts of radioles: muricate and striate. The specimens are so obscured by grains of matrix that interpretation is difficult, but I fancy the above account represents the facts. There was no doubt a good deal of variation in the radioles of even a single individual, but the general character of the radioles agrees with that of those found in the Zechstein. There is nothing to warrant the separation of the species.

There is therefore no ground for separating *C. verneuiliiana* and *C. keyserlingi* even specifically. Which trivial name should be adopted is a question not hitherto discussed. K. v. Schauroth (1854, p. 182) said "Der King'sche und der Geinitz'sche Name sind gleichzeitig entstanden, ein Prioritätsrecht besteht also nicht." This statement is surely unwarranted. King's 'Catalogue of the Organic Remains of the Permian [sic] Rocks of Northumberland and Durham' was "published by the author" at Newcastle-upon-Tyne, during the afternoon of Saturday, 19th August, 1848*. The description of "*Cidaris Verneuiliiana* n. sp." occurs on pp. 6 and 7 of that Catalogue. *Cidaris keyserlingi* was first described on p. 16 of H. B. Geinitz: 'Die Versteinerungen des deutschen Zechsteingebirges' (being Heft 1 of Geinitz and Gutbier: 'Die Versteinerungen des Zechsteingebirges und Rothliegenden'). The titlepage of this Heft is dated "Dresden und Leipzig, . . . 1848," and a review of it appeared in 'Neues Jahrbuch für Mineralogie,' Jahrg. 1848, pp. 504, 505. These pages are in the fourth of the six parts composing this Jahrgang, and assuming that the parts were published at regular intervals, this would give August 1848 for the date of publication of the review. This part contains letters of which the latest is dated 18 June, 1848, and it acknowledges the receipt of publications of which the latest seems to date from April 1848. Most of the works reviewed are of 1847, but a few appeared in the early months of 1848. One would naturally infer from this that the work of Geinitz was published not later than April or May of 1848. This agrees with a definite statement by R. Howse (Jan. 1857, p. 49) that Geinitz's 'Die Versteinerungen u. s. w.' was "published in the early

* *Fide* R. Howse, 'Note on the Right of Priority' [1857].

part of April 1848." The trivial name "*keyserlingi*" is therefore the one to be adopted.

We have now to enquire in what genus *Cidaris keyserlingi* should be placed. That it cannot be *Eocidaris* or *Archæocidaris* (= *Echinocrinus*) has been urged above. Professors Clark and Jackson, as intimated in my opening paragraphs, would refer it to *Cidaris*, while Mr. Lambert (April 1899, p. 82) has made it the genotype of *Etiaris*. The former course seems to me to ignore important structural differences, while the latter course lays undue stress on a very trifling feature. In the 'Triassic Echinoderms of Bakony,' I have referred *Cidaris keyserlingi* to Doederlein's genus *Miocidaris*. This genus also is regarded by Professor H. L. Clark as indistinguishable from *Cidaris*, an opinion with which I cannot agree.

MIOCIDARIS, ITS SPECIES AND STRUCTURE.

Since *Miocidaris* is fully discussed in the 'Triassic Echinoderms of Bakony,' from the nomenclatorial, anatomical, and faunistic standpoints, the conclusions there reached need but a brief summary here. On the other hand it has now become necessary to give reason for the distinction of *Miocidaris* from *Cidaris*.

Miocidaris was established by L. Doederlein in 1887 (p. 40), and from among the species referred to it by him I have selected as genotype *Cidaris klipsteini*, interpreting that to mean *C. klipsteini* Desor 1855, non Marcou 1847. Since a new name is needed for this species, I propose *Miocidaris cassiani*, attaching thereto as lectotype the interambulacral fragment figured by Klipstein (1843) in plate xviii. fig. 15, and now in the British Museum (regd. 36512).

With Lambert (1900) I remove *Cidaris subnobilis* to *Triadocidaris*, but include in *Miocidaris* the species *Cidaris subcoronata*, which Doederlein placed in an unnamed section 5.

It is probable that various species from the older Jurassic rocks, such as *Cidaris analthci* and *C. arietis* included by Doederlein, belong to *Miocidaris*; but I have not personally examined the type-specimens.

The interambulacrals from the Wellen-dolomite of the Schwarzwald which Quenstedt (1875, pl. lxxvii. fig. 115) referred to *Cidaris grandæva* are to be placed in *Miocidaris*. So also is the specimen from Kirchberg on the Jaxt, which is the holotype of *Cidaris coarva* Quenstedt (1875, p. 160, pl. lxxvii. fig. 110); this is No. 4254 of Tübingen Geological Museum, and I owe the opportunity of examining it to the kindness of Professor Koken and Dr. F. von Huene.

Quenstedt himself, as we have already noted, associated *Miocidarid coava* and *M. keyserlingi*.

From the Cassian and Raiblian beds of Bakony come five or six representatives of this genus, and for two of them new specific names are proposed in my memoir.

Examination of all this material has led to the following revised and extended Diagnosis of *Miocidarid*:—

A Cidarid of moderate size, with the adradial margin of the interambulacrum sharply bevelled on the inner surface, and usually, if not always, denticulate, thus flexibly imbricating over the ambulacrum. Interambulacral plates relatively few, often wide, with scrobicules circular or elliptic, distinct or confluent, with main tubercles small or of medium size, having crenelate bosses. Podial pores not yoked (?).

The differences between this diagnosis and the original one of Doederlein are explained and justified in my memoir. What we have now to consider is the inclusion of *Eotiarid*. Neither in 1899 nor in 1900 did Lambert attempt any diagnosis for his new genus, and one must assume that he adopted for it Doederlein's diagnosis of *Eocidarid* (1887), since that was based solely on the genotype of *Eotiarid*, *E. keyserlingi*. The only difference discoverable between Doederlein's diagnosis of *Eocidarid* and his diagnosis of *Miocidarid* is that the former has "Warzenhöfe elliptisch, etwas vertieft, zusammenfließend," while the latter has "Warzenhöfe rund, schwach vertieft." Klipstein, however, said of the scrobicule in the holotype of the genotype of *Miocidarid* (his fig. 15) that it was "sehr stark vertieft." Apart from this flat contradiction, the character cannot lead to a true generic division, for the species mentioned above present every degree of variation in this respect. The scrobicules of *Miocidarid keyserlingi* are certainly elliptical (or, more correctly, "meridionally compressed"), but it has been shown above that they are not always confluent. On the other hand, later species of *Miocidarid* may have compressed and confluent scrobicules. The change from circular to compressed scrobicules is one that takes place during the growth of an individual, and a similar change may take place in racial history, as does indeed seem to be the case in *Triadocidarid*. But if so, and in so far as it is of any value, a species with compressed scrobicules cannot be regarded as the ancestor of one with circular scrobicules; therefore if *Eotiarid* has any validity it cannot be the ancestor of *Miocidarid*, as Lambert maintains. Mr. Lambert may choose which horn of the dilemma he prefers; I prefer to drop a genus based on so slight and uncertain a character.

We return now to the statements of Professor Lyman Clark (1907, p. 175), who claims *Eocidaris* Doederlein as a synonym of *Cidaris*, and says that *Miocidaris* is "too near *Cidaris* and *Dorocidaris*." In two other notes (March and July 1908) I have discussed Professor Clark's application of these generic names, and have accepted Doederlein's relegation of *Dorocidaris* to the synonymy of *Cidaris* s. str. with genotype *C. papillata*. *Cidaris* as restricted by Clark with genotype *Cidarites metularia* Lam. is the genus or subgenus for which Doederlein (Nov. 1906, p. 100) has resuscitated the name *Cidarites*, but to which he previously (1887, p. 42) applied Pomel's preferable name *Eucidaris* (1883, p. 109). It is, however, unnecessary for our present purpose to consider all the minor details of tuberculation, of radioles, and of pedicellariæ, on which the modern genera, subgenera, or sections are largely based. There are far more important differences in the structure of the test. So far as I have been able to ascertain, the sutures between the interambulacral plates in these later genera are plane vertical joints, and do not present the bevels, grooves, and ridges of *Miocidaris*. At any rate, the sutures between the interambulacra and ambulacra are vertical and notched on the vertical surface for the reception of the ambulacrals; the firmness of this union is intensified by the thickness and solidity of the united plates. In *Miocidaris*, on the other hand, as first pointed out by Doederlein, the adradial margin of the interambulacrum is bevelled on its inner surface so as to slide over the ambulacrals, and the grooves, corresponding to the notches in *Cidaris*, are on the inner face; the ambulacra also thin off to the edges, and are throughout much less solid than in later genera. It is only towards the peristome that the plates thicken, to form a perignathic girdle, and that the adradial suture gradually bends to a more vertical position. The perignathic girdle of *Miocidaris* is even then not so stout as that of *Cidaris* and *Eucidaris*, and the auricular processes with which it is provided are nothing like so large or so well developed as in the later genera. Taking the broadest construction that anyone nowadays places on *Cidaris*, it does not seem to me that it can be so extended as to include these Permian and Triassic species. And if this be true of *Cidaris* in a wide sense, it is still more true of it in the restricted senses of Clark, of Doederlein, or of Mortensen.

PERMOCIDARIS.

There is still one genus needing discussion, namely *Permocidaris* Lambert (1900, pp. 39, 47), since the genotype

is *Cidaris forbesiana* Koninck, which Waagen (1885, p. 819, pl. xcv. figs. 5-16) referred to *Eocidaris*, and since Lambert also included in his genus two species that have been attributed to *Eocidaris*, namely *Cidaris verneuiliana* (not *C. keyserlingi*) and possibly *C. coæva* Quenst.

Lambert's remarks may be condensed into the following diagnosis:—An Archæocidarid with irregular, usually sub-octagonal interambulacral plates, each with a well-developed tubercle, perforate, crenelate, devoid of basal terrace, with smooth scrobicule surrounded by a circle of large granules. Radioles fusiform, spinulose.

Since I have not yet seen the material described by Waagen, I shall not waste space on discussing his figures and description. It should, however, be pointed out that De Koninck (1863, p. 4) based the species on radioles only, and that, since these have never been found in actual contact with the plates, the ascription of the latter to this species remains an assumption characterized by Waagen as "highly probable." It is, of course, on the evidence of the interambulacral plates that the genus is founded, and as regards these I will merely note that in most of Waagen's specimens the complete outlines were not preserved, so that the shapes attributed to them are further assumptions. Moreover, it seems impossible to reconstruct an interambulacrum out of plates with the outlines indicated. The orientation of the plates given by Waagen, when compared with the bevelling of their margins, is found to be quite out of agreement with the bevelling in other genera of the same general character. Waagen's account of the tuberculation is also perplexing and inconsistent with his figures.

Considering the uncertainty that has so long existed with regard to the shape of the interambulacrals in *C. verneuiliana* King, it seems quite possible that *C. forbesiana* is not really so anomalous as Waagen's account would lead one to suppose. If the structure of the interambulacra agrees with that of other Archæocidaridæ (Lepidocidaridæ mihi), then the sole feature in which it can be said with certainty to differ from *Eocidaris* (s. str.), *Archæocidaris* (= *Echinocrinus*), or *Cidarotropus* is the crenelation of the parapet. If, on the other hand, the interambulacra are of Cidaroid type, then reasons for separating the genus from *Miocidaris* have yet to be supported by adequate evidence.

In the former case it will be obvious to those who have read the preceding remarks on *C. verneuiliana* King and *C. coæva* Quenst. that those species cannot be placed in *Ermocidaris*. In the latter case *C. forbesiana* may prove

congeneric with those two species, and, if so, the name *Permocidaris* will be a synonym of *Miocidaris*.

SUMMARY AND CONCLUSIONS.

The genotype of *Eocidaris* was not fixed by Desor (1856) when he founded the genus. Subsequent authors have removed from the genus all species referred to it by Desor except *Cidaris levispina* Sandb. and *C. scrobiculata* Sandb., which are the only two that agree with Desor's diagnosis. But no author has yet selected a genotype. Therefore I select *C. levispina* Sandb. as genotype.

The original specimens of *Eocidaris levispina* are described and figured, and the original of Sandberger's pl. xxxv. fig. 2 a (1855) is selected as type (lecto-holotype). The holotype of *Cidaris scrobiculata* is also redescribed and figured, and considered congeneric with *C. levispina*. On this evidence *Eocidaris* is provisionally maintained as an independent genus of Archæocidaridæ (=Lepidocidaridæ). No other species are placed in *Eocidaris*.

Cidaris keyserlingi Geinitz, which has frequently been referred to *Eocidaris*, is discussed, and fresh details of its structure are given. Numerous topotypes of *Cidaris verneuiliانا* King are described and figured, and that species is proved a synonym of *C. keyserlingi*. The evidence thus adduced shows that these fossils belong to *Miocidaris* Doederlein (1887).

Miocidaris is rediagnosed and *M. cassiani* nom. nov. (= *Cidaris klipsteini* Desor, non Marcou) taken as genotype. The genus is distinguished from the recent *Cidaris*.

Other species examined and referred to *Miocidaris* are *Cidaris subcoronata* Münster, *C. grandæva* Goldf. on the evidence of Quenstedt's specimens (1875), and *C. coæva* Quenst. Others are alluded to.

It follows that there is no necessity for *Eotiaris* Lambert, founded to receive *Miocidaris keyserlingi*.

It also follows that *Cidaris verneuiliانا* King and *C. coæva* Quenst. cannot belong to *Permocidaris* Lambert, a genus that rests on the inadequately described *Cidaris forbesiana* De Kon.

EXPLANATION OF PLATE I.

Eocidaris levispina (Sandberger).

Fig. 1. Lecto-holotype. Interambulacral, original of Sandberger, pl. xxxv. fig. 2 a.

Fig. 2. Interambulacral, original of Sandberger, pl. xxxv. fig. 2 b.

Fig. 3. Interambulacral, original of Sandberger, pl. xxxv. fig. 2.

Fig. 4. Radiole, proximal end, original of Sandberger, pl. xxxv. fig. 2 d.

Eocidaris scrobiculata (Sandberger).

Fig. 5. Holotype. Interambulacral, original of Sandberger, pl. xxxv. fig. 3.

Miocidaris keyserlingi (Geinitz).

(a) Specimens from the Zechstein of Pössneck.

Fig. 6. Greater part of an interambulacrum, interior view, showing imbricate sutures, denticulation of adambulacral margin, and peristomial structures. Brit. Mus. E. 1121.

Fig. 7. Radiole, incomplete distally, longitudinally striate. Brit. Mus. E. 14,104.

Fig. 8. Interambulacral, to show nature of tuberculation. Brit. Mus. E. 1121, on another part of the rock-fragment that bears the original of fig. 6.*

(b) Specimens from the Magnesian Limestone of Tunstall Hill :
topotypes of *Cidaris verneuiliana* King.

Fig. 9. Greater part of an interambulacrum, interior view, showing denticulation of adambulacral margin and peristomial structures.

Fig. 10. Interambulacrals, from the adapical region of a small individual, showing slight interradiial tuberculation.

Fig. 11. Interambulacral from ambital region of a larger individual, showing well-marked scrobicular tubercles.

Fig. 12. Interambulacral from ambital region, with scrobicular tubercles not distinguished from the dense interradiial tuberculation.

Fig. 13. A similar interambulacral, with rather less interradiial tuberculation.

Fig. 14. Radiole, subcylindrical, longitudinally striate, non-muricate.

Fig. 15. Radiole, fusiform, muricate in longitudinal series.

Fig. 16. Radiole, fusiform, muricate in transverse series.

Fig. 17. Radiole, subfusiform, very slightly muricate.

Figures 1-5, representing *Eocidaris*, are enlarged 3 diameters. All are based on photographs, but owing to the dark colour and obscurity of the specimens the details have been emphasized.

Figures 6-17, representing *Miocidaris*, are enlarged 6 diameters.

Photographs by Mr. H. Herring. Drawings by Mr. G. T. Gwilliam and Mr. A. H. Scarle, under the direction of the author.

XI.—On the Anatomy and Classification of the Scombroide Fishes. By C. TATE REGAN, M.A.

MOST schemes of classification of the Teleostean fishes include a group Scombroidei or Scombriformes, comprising the Scombridae and Carangidae and a varying number of other families supposed to be related to them. In Boulenger's classification the Scombriformes form a division of the Acanthopterygii, but it is admitted that no good definition